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(54) Combustion-promoting additive composition for cleaning heating equipment, chimneys, smoke flues and heat regenerators

The invention relates to a combustion-promoting additive composition for cleaning heating equipment, chimneys, smoke flues and heat regenerators. The composition according to the invention contains 15 to 20 parts by weight ammonium derivative constituent, viz. ammonium carbonate and ammonium bicarbonate, 5 to 40 parts by weight magnesium derivative constituent, viz. magnesium oxide and magnesium carbonate, 5 to 30 parts by weight sodium chloride, 0 to 30 parts by weight ammonium sulphate, 1 to 5 parts by weight α-naphthoquinone, 0.1 to 1 part by weight copper naphthenate, 0.1 to 1 part by weight magnesium stearate, 4 to 9 parts by weight metallic oxide constituent, viz. aluminium oxide and iron (III) oxide as well as 0 to 6.5 parts by weight silicon dioxide and calcium oxide.

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Patent claims

1. Combustion-promoting additive composition for cleaning heating equipment, chimneys, smoke flues and heat regenerators, characterised in that it contains 15 to 20 parts by weight ammonium derivative constituent, viz. ammonium carbamate and ammonium bicarbonate, 5 to 40 parts by weight magnesium derivative constituent, viz. magnesium oxide and magnesium carbonate, 5 to 30 parts by weight sodium chloride, 0 to 30 parts by weight ammonium sulphate, 1 to 5 parts by weight α - naphthoquinone, 0.1 to 1 part by weight copper naphthenate, 0.1 to 1 part by weight magnesium stearate, 4 to 9 parts by weight metallic oxide constituent, viz. aluminium oxide and iron (III) oxide as well as 0 to 6.5 parts by weight silicon dioxide and calcium oxide.

2. Additive composition according to claim 1, characterised in that the total quantity of α - naphthoquinone, copper naphthenate and magnesium stearate is at least 3 parts by weight and at most 6 parts by weight.

3. Additive composition according to claim 1, characterised in that the total quantity of aluminium oxide, iron (III) oxide, silicon dioxide and calcium oxide is at least 9 parts by weight, the total quantity of sodium chloride and ammonium sulphate at least 30 parts by weight.

The invention relates to a combustion-promoting additive composition for cleaning heating equipment, chimneys, smoke flues and heat regenerators.

It is already known that the use of solid fuels has come to the fore; in addition the different mineral oil derivatives will, of course, continue to be used as fuels.

It is also known that all non-gaseous fuels are converted to ash, carbon dioxide, carbon monoxide, water sulphur dioxide and nitrogen monoxide during heating. The ash content of the fuels is 0.01 % (distilled fuel) to 40% (low-quality lignite). The ash may contain elements, which cause problems when both fuel oil and coal are used. These elements include, for example, sodium, potassium, nickel, iron, vanadium, silicon and sulphur. During heating these elements form an eutectic with a low melting point, which produces deposits, which are extremely difficult to remove, on the various parts of the heating equipment as well as in the second and third passes, in the smoke flues and also in the chimneys after melting and subsequent solidification. Formation of the deposits is determined by the particle size, melting point of the slag, the effect of inertia and the molecular diffusion. The deposits on the furnace side significantly reduce the boiler efficiency, increase the costs of specific steam generation and the emission of environmental pollutants, also constitute an accident hazard and create the conditions for the corrosion occurring at high and low temperatures. The technical literature of firing technology considers that the formation of the above-mentioned deposits is clearly unfavourable and describes various mechanical methods and additives for removal of the deposits and for prevention of their formation. The already known solutions can be divided into three groups, viz.:

1) Mechanical method, e.g. use of a wire disc or wire brush, scraping, chiselling, knocking out with steam or water.

2) Cleaning with chemicals, the essential feature of which is that a substance, which can remove the deposits, is applied to the surfaces of the heating equipment to be cleaned, after which the dissolved deposits are removed.

3) Use of fuel additives, whereby the suitable additive is introduced into the heating space together with the fuel or at the same time and the heating carried out in this way. The advantage of the use of fuel additives is that the heating equipment need not be shut down during cleaning, hence no energy loss occurs in this case. A further advantage of these additives is that the cleaning with additives does not require much operating time.

The aim of our invention is to work out an additive composition, which can be used in all heating equipment and when heating with all types of fuel, and cleans the heating equipment, smoke flues, heat regenerators and also chimneys – which cause major technical problems – far more effectively than the additives known from the technical literature.

The importance of the additives in the firing technology has already been mentioned and it became obvious that the future of the removal of the deposits lies in the use of different additives. Such additives are described in FR-PS 2 044 640. According to this patent a salt mixture with the following composition to improve the combustion of anthracite or lean coal is used in a quantity of 0.16%: NaCl – 60%, CaO – 4%, NH_4 Cl - 28%, S - 4% as well as 2% permissible impurities and a small quantity of water. When using this additive soot formation and air pollution were reduced. The HU-PS 166853 describes a cleaning material, composition for cleaning the fire side of the heating equipment. The following composition is used in this case: ammonium sulphate or ammonium bisulphate – 37 to 57%, sodium chloride – 42 to 62%, graphite powder – 0.5 to 2% and if necessary 0.5 to 0.1% emulsifier.

According to DE-PS 2 501 503 the sulphur content of the sulphur-based fuels may be partially combined with dolomite or limestone-based materials.

As evident from the above comments, it was possible to use a specific composition in the known solutions depending on the fuel or the composition was suitable only for cleaning specific parts, e.g. of furnace sides

of the heating equipment. On the basis of our tests the currently known compositions for elimination or reduction of the reaction converting sulphur dioxide to sulphur trioxide are unsuitable.

The aim of the invention is to work out a composition, the use of which enables effective removal of the deposits in heating equipment, chimneys, smoke flues and heat regenerators regardless of the fuel.

The essential feature of the composition according to the invention is that it contains 15 to 20 parts by weight ammonium derivative constituent, viz. ammonium carbamate and ammonium carbonate, 5 to 40 parts by weight magnesium derivate constituent, viz. magnesium oxide and magnesium carbonate, 5 to 30 parts by weight sodium chloride, 0 to 30 parts by weight ammonium sulphate, 1 to 5 parts by weight α-naphthoquinone, 0.1 to 1 part by weight copper naphthenate, 0.1 to 1 part by weight magnesium stearate, 4 to 9 parts by weight metallic oxide constituent, viz. aluminium oxide and iron (III) oxide as well as 0. to 6.5 parts by weight silicon dioxide and calcium oxide.

According to the experience acquired in the tests the composition is most effective when the total quantity of α- naphthoquinone, copper naphthenate and magnesium stearate is at least 3 parts by weight and at most 6 parts by weight, the total quantity of aluminium oxide, iron (III) oxide, silicon dioxide and calcium oxide at least 9 parts by weight and the total quantity of sodium chloride and ammonium sulphate at least 30 parts by weight.

With regard to the action mechanism of the additive we ascertained that the composition according to the invention quickly becomes gaseous as a result of the action of α- naphthoquinone, which promotes sublimation and also reaches the furthest parts of the heating equipment, the heat regenerators and the chimneys. As a result of molecular diffusion and adsorption it passes between the wall of the heating equipment and the deposits and then evolves carbon dioxide. The effect of the gas evolution causes the deposits to separate from the metal surface.

It was not possible to clean the heat regenerators and chimneys with the already known additives. Hence the composition according to the invention constitutes an important advance compared to the already known additives.

The composition according to the invention reduces the SO_2 - SO_3 reaction not only far more significantly than the already known additives, but almost eliminates it in that the SO_3 formed during the combustion is reduced and a dry, porous slag is obtained as a result of the increase in the melting point of the slag. The composition according to the invention also reacts directly with the sulphur oxides. During the reaction complexes, which do not cause deposits or corrosion, are formed, hence the corrosion occurring at high temperatures is eliminated. It was found that the composition according to the invention acts like a negative catalyst in the SO_2 - SO_3 reaction. As already known, the temperature of the waste gas in the heat regenerators of the heating equipment falls below the acid dew point, which promotes formation of the sulphurous acid on the metal surfaces and the corrosion occurring at low temperatures thus takes place. This film-type sulphurous acid may cause acid soot deposits, which may finally lead to interruption of operation and energy losses. To prevent the corrosion occurring at low temperatures energising solutions were applied, but they are uneconomical, because gases with thermal energy escape into the atmosphere, i.e. an energy loss occurs.

The additive composition according to the invention reduces the required excess air as a result of its combustion-promoting catalytic effect and thus also reduces the flow rate of the waste gas. As a result of the lower flow rate the number of inertia effects will also be smaller and this reduces the formation of deposits. The composition according to the invention prevents the formation of SO_3 and fully neutralises the sulphurous acid on the parts of the heat regenerators with low temperatures. The contamination can be eliminated, because the metal surface will not become tacky. This can be achieved by the fact that the additive composition keeps the dew point of the sulphurous acid below the operating temperature. The heating equipment can thus operate with minimum waste gas temperature and chimney temperature and at the same time utilise maximum energy quantity.

During the tests we found that good results can already be obtained by using 0.5 kg composition according to the invention per 1000 kg fuel. On the basis of the tests it is advisable to use 0.5 to 0.8 kg combustion-promoting additive composition per 1000 kg fuel depending on the quality of the latter.

The composition according to the invention is shown in more detail by the following examples without restricting the invention to the latter.

	Example 1	Example 2	Example 3	Example 4
∝ - naphthoquinone	5 parts by wt.	1 part by wt.	2.9 parts by wt.	3 parts by wt.
Copper naphthenate	0.5 part by wt.	1 part by wt.	0.1 part by wt.	1 part by wt.
Magnesium stearate	0.5 part by wt.	1 part by wt.	0.1 part by wt.	1 part by wt.
$Al_2 0_3$				
$Fe_2 0_3$	6 parts by wt.	4 parts by wt.	9 parts by wt.	8 parts by wt.
$Si 0_2$				
Ca0	3.5 parts by wt.	6.5 parts by wt.	---	4.5 parts by wt.
Ammonium bicarbonate				
Ammonium carbamate	15 parts by wt.	20 parts by wt.	18 parts by wt.	17.5 parts by wt.
Mg 0				
$Mg C0_3$	30 parts by wt.	40 parts by wt.	17 parts by wt.	5 parts by wt.
NaCl	20 parts by wt.	30 parts by wt.	5 parts by wt.	30 parts by wt.
Ammonium sulphate	20 parts by wt.	-	30 parts by wt.	25 parts by wt.